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EDUCATION

Ph.D., **Carnegie Mellon University**, Pittsburgh, PA (Sept. 1999)
Electrical and Computer Engineering (GPA: 3.98/4.0)
Thesis: Nonlinear feature extraction for computer vision and pattern recognition
Advisor: D. Casasent, George Westinghouse Professor of Electrical and Computer Engineering

M.S., **Iowa State University**, Ames, IA (Aug. 1994)
Electrical and Computer Engineering (GPA: 3.85/4.0)
Thesis: Partially ordered Markov models for texture synthesis & image segmentation
Advisor: J. Davidson, Associate Professor of EECPE

B.S., **Osmania University**, India (May 1992)
Electronics and Communication Engineering

EXPERIENCE

Senior Member of Technical Staff - Category A,
In-situ Instruments Section, Jet Propulsion Laboratory/NASA/California Institute of Technology (Nov. 1999 -Present)

- Technical Principal Investigator, "Multimodality in-situ alcohol sensing and quantitation system (MUSIQ)", funded by NIH/NIAAA. $3.6 million total award.
  Collaborating Institutions: Boston University, SpectRx Inc.
  Start: June 2003, End: June 2008.
- Co-Investigator in competed & funded DARPA IPTO Robotics 2020 contract ($4.0 million total award).
  Collaborating institutions: JPL, Carnegie Mellon University, SRI, UC Santa Cruz.
  Start date: Sept. 2002 : End: Sept 2004
- Co-Investigator in funded DARPA IPTO Mobile Robot Software Program ($800,000 total award). End: Sept 2002
- Co-Investigator in Digital Personnel task funded by NGMTec. ($220,000 award). Start Sept 2002

- Team/project leader on several NASA, DARPA-DoD and commercial projects
- Designed and implemented algorithms for real-time face detection and accurate recognition of facial features for low-bandwidth videoconferencing and video-based instant messaging
- Algorithm and software development for intra-oral plaque analysis involving object segmentation and classification
- Computer vision algorithm development for detection and characterization of obstacles for autonomous vehicles on natural terrain, and techniques to model and visualize vehicle movement under different terrain conditions.
- Developed new obstacle negotiation techniques for unmanned ground vehicles using novel sensor fusion of color, 3D shape, and texture information.

Research Assistant, Carnegie Mellon University (Aug. 1994-Oct 1999)

- Directed groups of 1-2 students on several projects and worked in highly diverse groups of 2 to 15 people
- Assisted in writing several proposals for research funding (one proposal resulting in grant of $150,000)
- Presented research work at several conferences, workshops and meetings
- Thesis work involves development of novel nonlinear feature extraction algorithm implemented as a neural net with pre-determined weights applied to active vision, face recognition, classification of defective products. Simultaneously worked on multiple projects for microscopy & biomedical image processing, ATR.

Teaching Assistant, Carnegie Mellon University (Aug. 1996-Dec. 1996)

- Assisted in teaching graduate course "Optical Image and Radar Processing", presented few lectures
- Designed and graded assignments and exams; Organized a lab on optical image processing techniques

Research Assistant, Iowa State University (Aug. 1992-1994)

- Asst. system administrator for image processing lab; tested stochastic image modeling methods
- Implemented various deterministic and statistical numerical optimization methods

PROJECTS

Dynamic Perception for Unmanned Vehicles, DARPA-IPTO (Nov. 2002 – Current)

- Algorithm design and development for detection of moving objects from moving robotic platforms
- Novel algorithms for autonomous scene characterization and recognition of dynamic objects in urban environments
- Development of outdoor, urban localization and pose estimation techniques for pecept-referenced navigation.

Autonomous Terrain Perception and Modeling for Robots, DARPA-IPTO (Oct 2000 – Oct. 2002)

- Computer vision algorithm development for detection and characterization of obstacles for autonomous vehicles on natural terrain, and techniques to model and visualize vehicle movement under different terrain conditions.
- Developed new obstacle negotiation techniques for unmanned ground vehicles using novel sensor fusion of color, 3D shape, and texture information.

Face Detection and Feature Segmentation, Graphco Technologies (Dec. 2000 – April 2001, Sept 2002 -)

- Designed and implemented algorithms for real-time face detection and accurate recognition of facial features for low-bandwidth videoconferencing.
- Constructed new support vector machine classifier for detection and active appearance models for facial feature segmentation

Automated Plaque Classification, Analysis and Visualization, Colgate-Palmolive (Nov 1999 – Apr. 2001)

- Algorithm and software development for intra-oral plaque analysis involving new and robust object segmentation and classification
- Developed computer graphics morphing and visualization tools to facilitate analysis of processed data
- Product delivered to Colgate-Palmolive and expected to save millions of dollars in Colgate R&D.

Non-Destructive Product Inspection And Classification, USDA (Sept. 1995 – Nov. 1999)

- Conceptualized, developed all stages of system for classification of pistachio nuts from X-ray images
- Implemented fast detection of randomly scattered pistachios on conveyor belt, segmentation of touching nuts using a watershed algorithm, and classification of each detected/segmented nut using neural networks
- Software was successfully tested at Agriculture Research Services; R&D work resulted in USDA grant

Microscopy Image Processing, NSF (Aug. 1996 - Present)

- Key member in design and development of software to automate image processing for data collection from microscope images of metal samples for Material Science
- Algorithm involving Gabor filter fusion & fast skeletonization sped up data collection by factor of 104
- Involves close collaboration with scientists in Material Sciences and Mathematics departments at CMU
- Innovations during this project resulted in application for U.S. Patent, and possibly a start-up company
- Directed M.S. candidate to implement algorithm on Matrox Genesis board with TMS C80 DSP.

Active Vision for Robotics, NSF (Jan. 1997 - Present)

- Designed novel automated feature extraction method and neural net classifier for simultaneous classification and pose estimation of machined parts from their images.
- Algorithm useful in robotics and computer vision applications.

Pose-Invariant Face Recognition (Aug. 1997 - Present)

- Developed technique to determine pose of unknown face with left/right and up/down motion
- Algorithm developed and tested to transform face at any unknown pose to a fixed reference pose
- Method removes distortions due to pose variations and requires single training and test images at any pose
- Nonlinear features extracted from pose-transformed faces gave superior recognition than eigenfaces method.

Automatic Target Recognition from IR Imagery, DARPA (Aug. 1994 - Dec. 1996)

- Helped develop and extensively tested fuzzy algorithm fusion methods to increase detection rates of low-contrast targets and reduce false alarms in FLIR images with high clutter.

Stochastic Image Modeling, NSF (Aug. 1992 - Jul. 1994)

- Developed and tested new causal Markov models for multidimensional processes allowing easier parameter estimation and segmentation of textured images compared with other MRFs
- Implemented method for real-time synthesis of natural textured objects.

SOFTWARE

- C, C++, Tk-Tcl programming for image processing, Open GL, Open Inventor
- OS: Unix/Ultrix/Linux, Sun OS, Win '95
- Packages: MATLAB, ACIS (solid-modeler), KHOROS, Shell utilities

PATENTS AND HONORS

- Receipient of NASA Space Act Award 2003 and monetary award ($1000) for software and algorithm development for Intra-plaque analysis system.
- Provisional Patent (NPO-30417) "Automated Intra-oral plaque analysis system" filed through the California Institute of Technology Intellectual Property Office for work on Colgate-Palmolive funded PlaqTrak System (Nov 2001).
- Provisional Patent (JPL and NASA Case No. NPO 30699) " New Real-Time Slice-based Processing and Eye-Gaze Mapping Software Application", filed through the California Institute of Technology Intellectual Property Office for work on NASA-funded Eyetracker for Biomedical Applications.
- Provisional Patent (JPL and NASA Case No. NPO 30700) " Novel System Software and Hardware Architecture for Optimized Real-time Non-invasive Eyetracking", filed through the California

Institute of Technology Intellectual Property Office for work on NASA-funded Eyetracker for Biomedical Applications.

- NASA NTR # 40377, "Real-time optical flow computation for computer vision-based applications" filed through the California Institute of Technology Intellectual Property Office for work on DARPA-funded Dynamic Scene Perception project
- Premium Award for Academic Excellence (PACE) received at Iowa State University
- Patent disclosure for development and implementation of algorithm to automate microscopy imaging system (CMU Internal Disclosure Number 99-037) entitled "Mesoscale Interface Mapping System"

SERVICE

- Technical Program and Organizing Committee Member of Optical Pattern Recognition Committee at the Annual SPIE Conference on Defense and Security (Formerly SPIE Annual Conference on Aerospace/Defense Sensing, Simulation, and Controls)
- Conference session chair for Optical Pattern Recognition XIV at 2003 SPIE Conference on Aerospace/Defense Sensing, Simulation, and Controls, Orlando, FL
- Chaired session on "Active Vision in Robotics" at 1998 SPIE conference on "Intelligent Robots and Computer Vision XVII: Algorithms, Techniques, and Active Vision"
- Chaired two sessions at 1998 SPIE Conference on Aerospace/Defense Sensing, Simulation, and Controls, Orlando, FL
- Reviewer/referee on IEEE Transactions on Image Processing
- Reviewer/referee on IEEE Transactions on Signal Processing
- Reviewer/referee on IEEE Transactions on Systems, Man and Cybernetics - Part B
- Reviewer/referee on Pattern Recognition journal
- Reviewer/referee on Neurocomputing journal
- Reviewer/referee on Applied Optics journal
- Reviewer/referee on Optical Engineering journal.
- Reviewer/referee on the Computer Vision and Pattern Recognition Conference (CVPR) 2003

GRANTS, AWARDS AND CONTRACTS

- Technical Principal Investigator: *MULTI-MODALITY SENSING FOR IN VIVO ALCOHOL QUANTITATION USING INTEGRATED OPTIMIZATION (MUSIQ*) Broad Area Announcement No. BAA-02-01, Integrated Alcohol Sensing and Data Analysis System, National Institute on Alcohol Abuse and Alcoholism (NIAAA). **Total Award: $3.6 million**.

  Start Date: June 2003. End date: June 2008

  Collaborating Institutions: Boston University, and SpectRX.

- Co-Investigator in competed & funded DARPA IPTO Robotics 2020 contract *Object-Referenced Robot Navigation in Dynamic Urban Environments* (**Total Award: $4.0 million**).

  Collaborating institutions: JPL, Carnegie Mellon University, SRI, UC Santa Cruz.

  Start date: Sept. 2002 : End: Sept 2004

- Co-Investigator in funded DARPA IPTO Mobile Robot Software Program *Learning Autonomous Terrain Classification for Cross-Country Navigation* (**Total Award: $800,000**). End: Sept 2002

- Co-Investigator in Digital Personnel task funded by NGMTec. (**Total Award: $220,000**). Start Sept 2002

PUBLICATIONS

JOURNALS AND BOOK CHAPTERS

- "Mapping the mesoscale interface structure in polycrystalline materials", Wu, C.T.; Adams, B.L.; Bauer, C.L.; Casasent, D.; Morawiec, A.; Ozdemir, S.; Talukder, A. **Journal of Ultramicroscopy**, Volume: 93 (2), 99-109, 2002

- "A closed-form neural network for discriminatory feature extraction from high-dimensional data", A. Talukder and D. Casasent, **Neural Networks**, Vol 14, No. 9, Nov. 2001, pp. 1201-1218.

- "Nonlinear features for improved pattern recognition", David Casasent, A. Talukder, **Book Chapter** in **Optical Information Processing: A Tribute to Adam Lohmann**, H. John Caulfield (Editor), SPIE Press, 2002

- "General Methodology for Simultaneous Representation and Discrimination of Multiple Object Classes", A. Talukder and D. Casasent, **Optical Engineering Journal** (**Advances in Recognition Techniques**), Vol 37, No. 3, Mar. 1998.

- "Detection and Segmentation of Items in X-Ray Imagery", David Casasent, A. Talukder, P. Keagy, T. Schatzki. **Transactions of the ASAE**. Vol. 44(2): 337–345, 2001.

- "Classification of Pistachio Nuts from X-ray Images", David Casasent, Ashit Talukder, Thomas F. Schatzki and Pamela M. Keagy, Accepted for publication at **the Intl. Journal for Food Science and Technology (LWT) published by the International Union of Food Science, and Technology**, Academic Press, London. (April 2003)

KEYNOTE ADDRESS AT CONFERENCES

- "Nonlinear features for robotics, inspection, and face recognition", D. Casasent and A. Talukder**, Keynote Address, Proceedings SPIE: Algorithms, Devices, and Systems for Optical Information Processing III, Conference on Photonics in Computing Systems**, Vol. 3804 Jul. 1999.

PEER-REVIEWED CONFERENCE PUBLICATIONS

- "Real-time detection of moving objects in a dynamic scene from moving robotic vehicles", ", A. Talukder, S. Goldberg, L. Matthies, and A. Ansar, Accepted for Oral Presentation at the **IEEE Intelligent Robots and Systems Conference (IEEE IROS) 2003**.

- "Fast and Reliable Obstacle Detection and Segmentation for Cross-country Navigation", A. Talukder, R. Manduchi, L. Matthies, and A. Rankin, **IEEE Intelligent Vehicles Symposium 2002**, June 2002, France.

- "Autonomous Terrain Characterisation and Modelling for Dynamic Control of Unmanned Vehicles", A. Talukder, R. Manduchi, R. Castano, K. Owens, L. Matthies, A. Castano, R. Hogg, **IEEE Intelligent Robots and Systems Conference (IEEE IROS) 2002**, Switzerland, Sept 30-Oct 2, 2002

- “Real-time Non-Invasive Eyetracking and Gaze-point Determination for Human-Computer Interaction and Biomedicine”, Ashit Talukder, John-M. Moorokian, S. Monacos, R. Lam, C. LaBaw, **2nd WSEAS Int. Conf. on Signal, Speech and Image Processing (ICOSSIP 2002),** Greece, Sept 28-30, 2002.

- "Adaptive activation function neural net for face recognition" (Tracking ID: 30629), David Casasent, A. Talukder, **Intl. Joint Conf. Neural Networks (IJCNN) 2001**, Jul. 2001

- "Nonlinear features for improved pattern recognition", David Casasent, A. Talukder, **Proc. SPIE AeroSense Conference**, April 2001, Orlando, Florida.

- D. P. Casasent, A. Talukder, “Nonlinear features for pose invariant face recognition”, Proc. SPIE **Wavelet Applications VIII, Aerosense Technologies and Systems for Defense & Security**, Vol. 4391, April 2001.

- "Face recognition with pose variations", David Casasent, A. Talukder, Proc. SPIE Vol. 4197, p. 1-4, **Intelligent Robots and Computer Vision XIX: Algorithms, Techniques, and Active Vision**, Oct. 2000

- “Neural Net with Adaptive Functions for Face Recognition”, David Casasent, A. Talukder, **Intl. Joint Conf. Neural Networks (IJCNN) 2000**, Jul. 2000

- “Pose Invariant Recognition of Faces with Unknown Pose”, A. Talukder and D. Casasent, **Intl. Joint Conf. Neural Networks (IJCNN) 1999** (and journal paper in preparation), Jul. 1999.

- “Distortion-Invariant Object Representation and Discrimination Using an FST Neural Net”, D. Casasent, M. Sipe and A. Talukder, **1998 Intl. Joint Conf. on Neural Networks (IJCNN’98)**, May 1998.

- "Accurate Multiscale Gabor Wavelet Fusion for Edge Detection in Microscopy Images" (Invited Paper), A. Talukder, D. P. Casasent, Proc. SPIE, **Wavelet Applications V**, 3391, Apr. 1998 (Also printed in **Selected Key SPIE Papers on CD-ROM series, Vol 8: Mathematical Imaging and Vision**, Ed. Dr. Gerhard Ritter, Dec. 1999).

- "Automated Estimation of Class and Pose of Machined Parts", A. Talukder and D. Casasent, **Robotics and Machine Perception Newsletter**, 1999.

- "Pose Estimation and Transformation of Faces from Single Views", A. Talukder and D. Casasent, Proc. SPIE: **Robots and Computer Vision XVII**, Nov. 1998

- "Classification and Pose Estimation of Objects using Nonlinear Features", A. Talukder and D. Casasent, Proc. SPIE: **Applications and Science of Computational Intelligence**, Vol. 3390, Apr. 1998.

- "Classification of Product Inspection Items Using Nonlinear Features", A. Talukder and D. Casasent, Proc. SPIE, **Optical Pattern Recognition IX**, Vol. 3386, Apr. 1998.

- "X-Ray Sensor Agricultural Product Inspection" (Invited Article), A. Talukder and D. Casasent. **Robotics and Machine Perception Newsletter (special issue on Machine Vision)**, 1998, p. 9-11.

- "X-Ray Agricultural Product Inspection: Segmentation and Classification", D. Casasent, A. Talukder, H.W. Lee. Proc. SPIE, **Intelligent Systems & Advanced Manufacturing**, 3205, Oct. 1997.

- "Image processing for grain boundary detection in microscope images", A. Talukder, D. Casasent and S. Ozdemir**, Proc. International Grain Growth Conference** (ICGG-3), Jun. 1998.

- "Detection of bands in backscatter microscopy images using new Hough transform techniques", D. Casasent, L. Chen and A. Talukder, Proc. SPIE, **Hybrid Image and Signal Proc. VI**, Vol. 3389, Apr. 1998.

- "Real-Time Robust Line Detection in Microscopy Images", A. Talukder and D. Casasent. Proc. SPIE (**Intelligent Systems and Advanced Manufacturing**), 3208, Oct. 1997.

- "Joint Recognition and Discrimination in Nonlinear Feature Space", A. Talukder and D. Casasent. Proc. **SPIE (Intelligent Systems and Advanced Manufacturing**), 3208, Oct. 1997.

- "Automated Segmentation and Feature Extraction of Product Inspection Items", A. Talukder and D. Casasent. Proc. SPIE (**AeroSense**), Apr. 1996.

- "Algorithm fusion for detection with reduced false alarms", Casasent D., Ye A., Talukder A. Proc. SPIE (**Optical Pattern Recognition VII**), vol.2752, p. 206-213

- "Feature space trajectory neural net classifier: confidences and thresholds for clutter and low contrast objects", Neiberg L., Casasent D., Talukder A. **Proc. SPIE (Applications and Science of Artificial Neural Networks II**), vol.2760, p. 435-46.

- "Detection algorithm fusion concepts for computer vision", Casasent D., Anqi Ye, Talukder, A. Proc. SPIE (**Intelligent Robots and Computer Vision XIV**), vol.2588, p. 2-9.

- "Model selection and texture segmentation using partially ordered Markov models", Talukder, A., Davidson, J. 1995 **International Conference on Acoustics, Speech, and Signal Processing** (ICASSP-95), p. 2527-2530.

- "Texture analysis using partially ordered Markov models", Davidson, J., Talukder, A., Cressie, N. Proc. ICIP-94 (**Proceedings of 1st International Conference on Image Processing**), 1994, p. 402-406.